RT7310 Evaluate Report for Triac Dim Bulb EVB (Buck-Boost)

ACDC BU / SLM Division
July 2016

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RT7310 Brief Introduction

RT7310 is an active power factor correction controller specifically designed for using as a constant current LED driver.

Supporting:
Isolation: PSR Flyback
Non-isolation: PSR Buck-Boost

Applications ➡ TRIAC Dimmable LED Driver

RT7310 Features

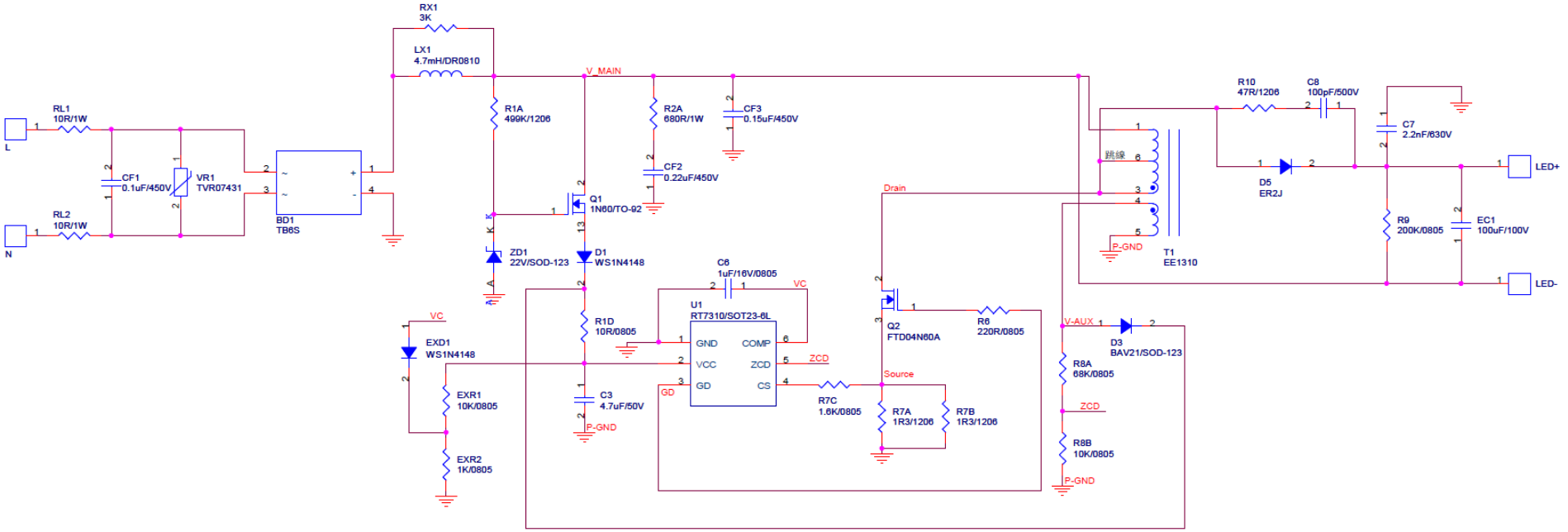
Phase-Cut Dimmable Primary-Side Regulation LED Driver Controller with Active PFC

- Primary Side Regulation(PSR)
- Power Factor Correction(PFC)
- Critical conduction mode(CRM)
- Max/Min switch frequency clamping
- Max/Min on time limitation
- THD Optimization
- Supporting Phase-Cut Dimmers

RT7310 Advantage

- Tight LED Current Regulation
- Protection:
  a. LED open-circuit protection
  b. LED short-circuit protection
  c. Output diode short-circuit protection
  d. Vdd under/over voltage protection
  e. Over temperature protection
  f . Cycle-by-cycle current limitation

Circuit



Electrical Performance

Test condition: burn-in 10min. , Ta = 26℃

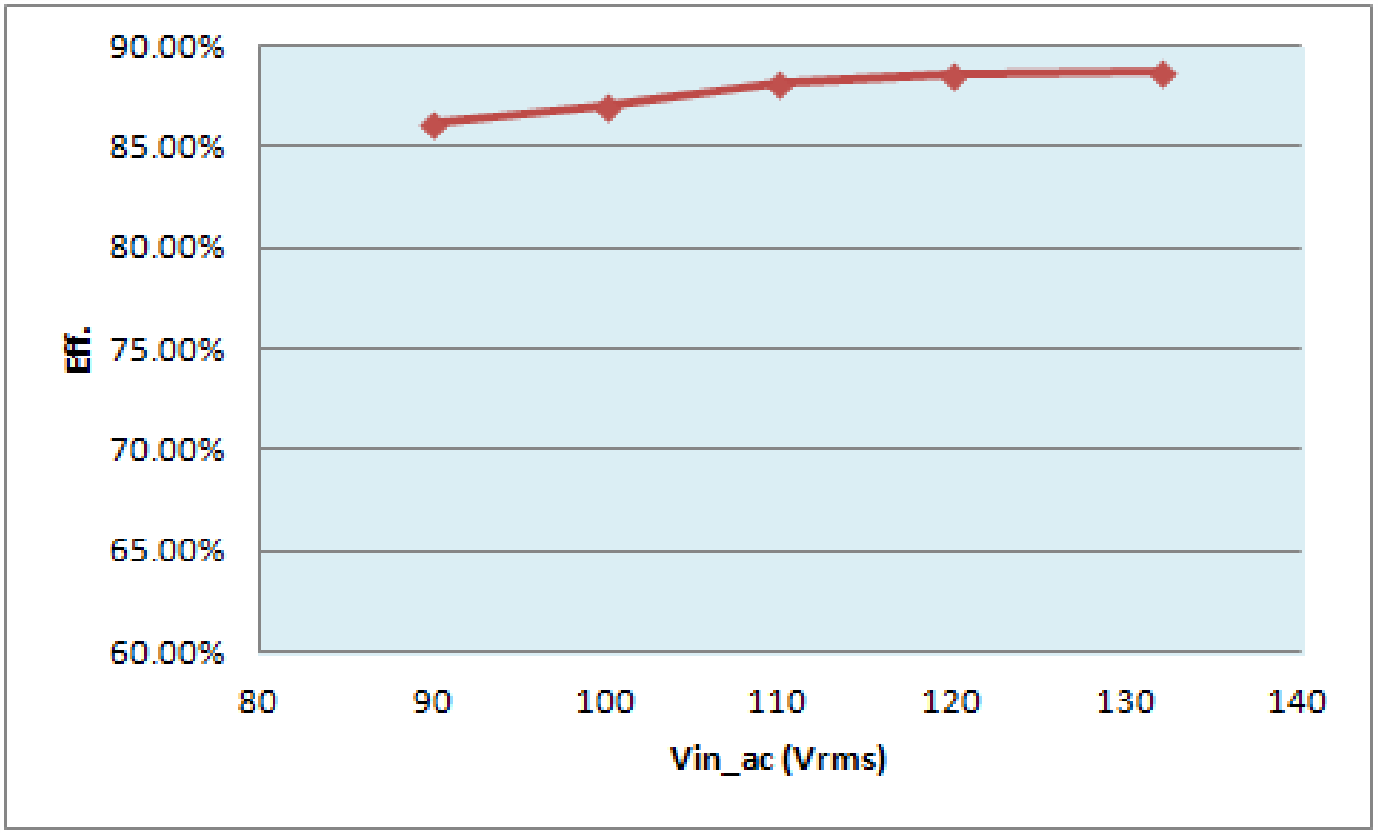
Load: LED 24 Series without dimmer

Line filter off

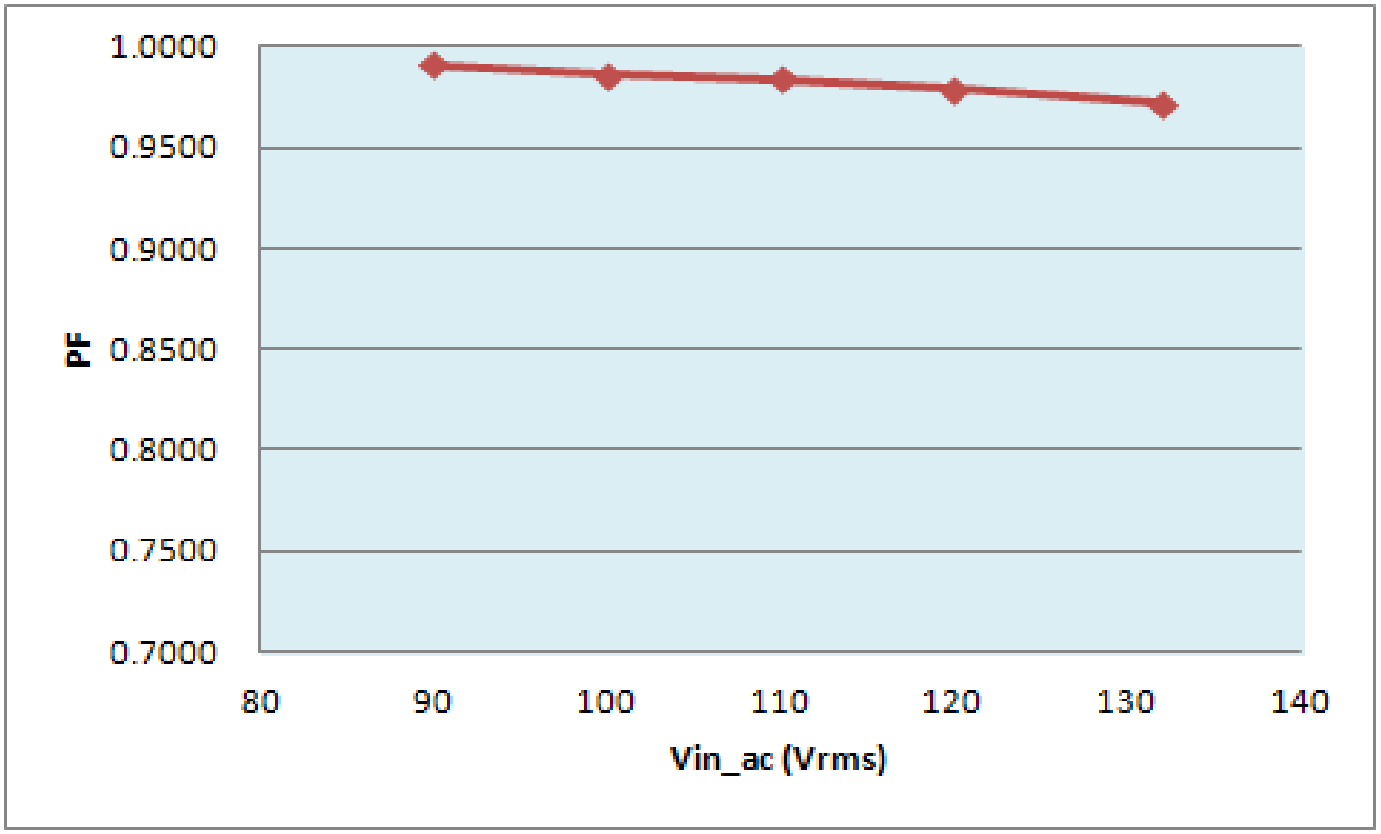
Frequency	Vac [V]	Iac [mA]	Pin [Watt]	V-LED [V]	I-LED[mA]	Eff. [%]	PF	THDi
60Hz	90	162	14.59	73.95	170	86.17%	0.9910	9.5500
60Hz	100	149	14.82	74.11	174	87.01%	0.9860	10.4200
60Hz	110	136	14.8	74.13	176	88.15%	0.9840	11.3200
60Hz	120	125	14.82	74.16	177	88.57%	0.9790	12.0400
60Hz	132	114	14.89	74.19	178	88.69%	0.9720	12.6500

90~132Vac current regulation =	4.49%	(+/-2.25%)
100~120Vac current regulation =	1.69%	(+/-0.85%)
△ Effiency =	2.52%	
Maximum PFC =	0.991	
Minimum PFC =	0.972	

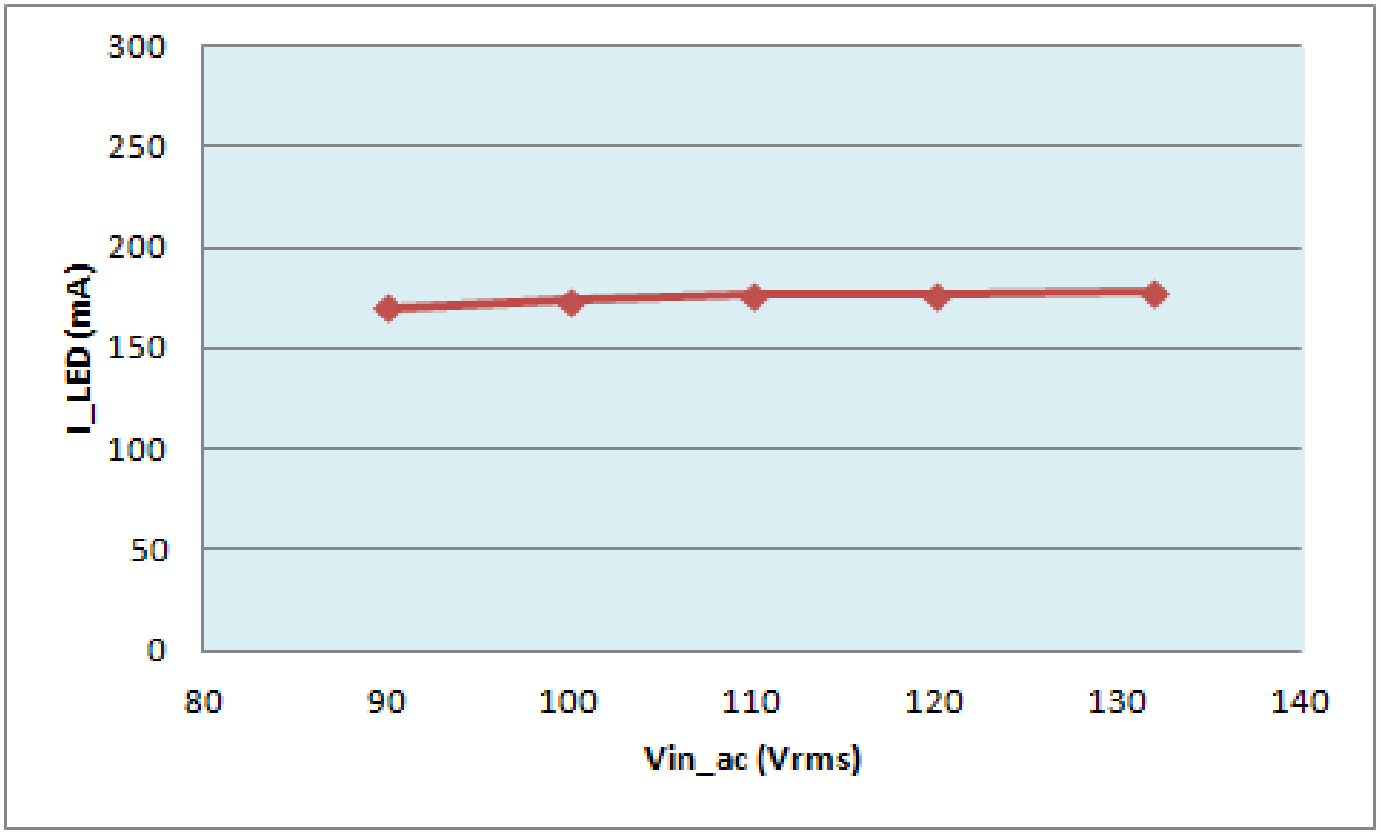
Efficiency



Power Factor

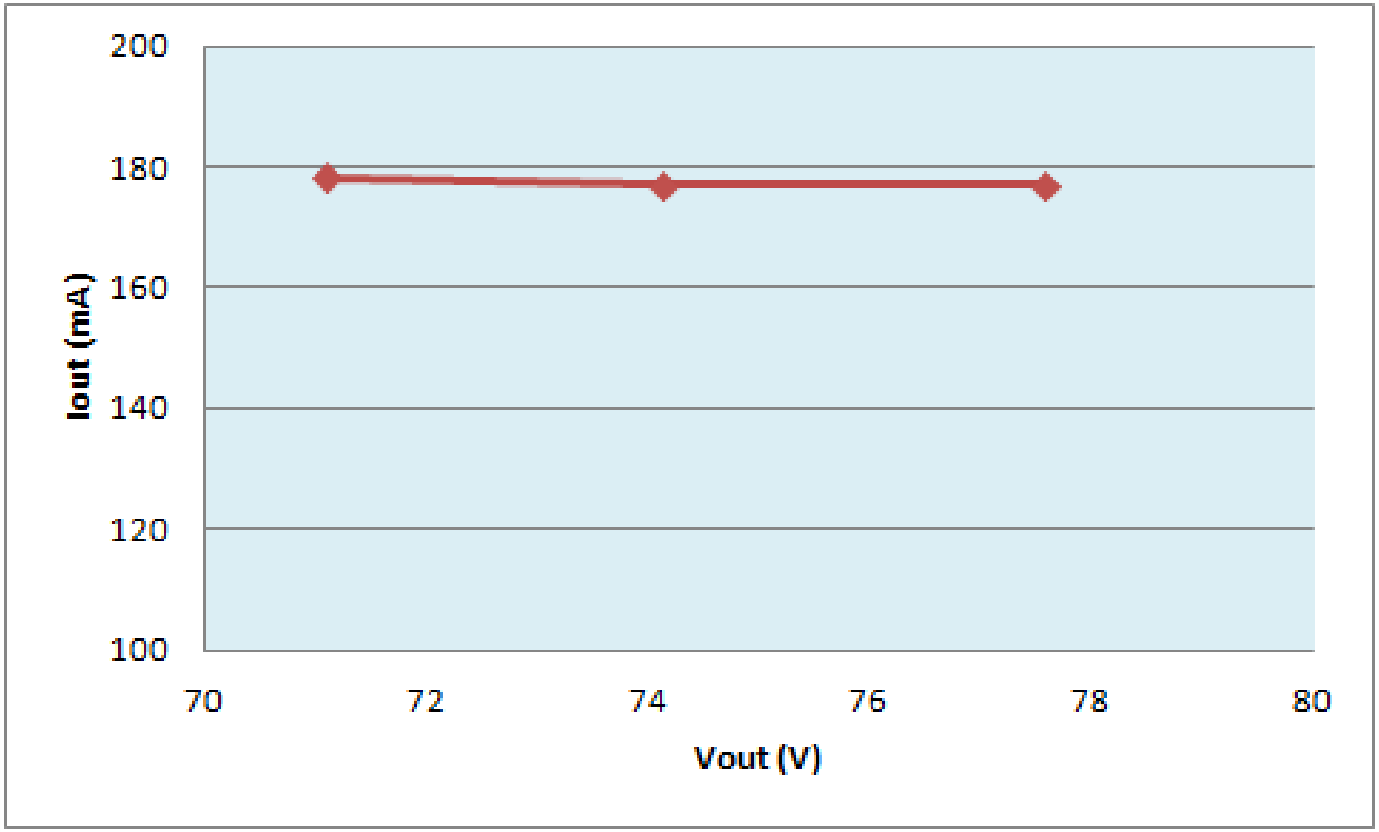


Current Regulation



Load Regulation

Frequency	Vac [V]	Vout [V]	Iout [mA]	Load Regulation
60Hz	120	71.11	178	0.55%
60Hz	120	74.16	177	
60Hz	120	77.6	177	



Triac Dimmer Compatibility (1)

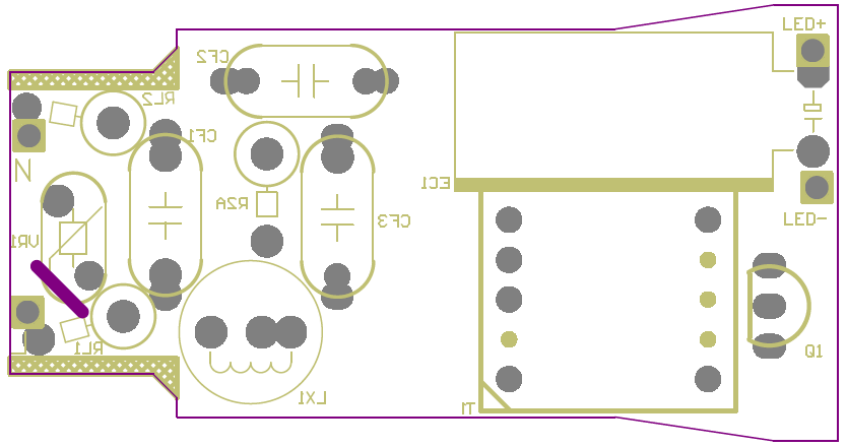
Item	Brand	Model	Load MAX. (Unit:W)	Poles	Dimming Range (in watts)	Led current Range (Unit:mA)	Flickering situation	Brightness duty_min (Unit: %)
1	Lutron	TG-600PNLH	600W 120V / 60Hz	Both	15.4 - 1.79	178 - 13	No	7.30%
2	Lutron Skylark	S-600P	600W 120V / 60Hz	Both	15.5 - 1.06	178 - 6	No	3.37%
3	Lutron	CN-600P	600W 120V / 60Hz	Both	15.5 - 1.6	178 - 11	No	6.18%
4	Lutron Skylark	SELVB-300P	300W 120V / 60Hz	3 Way (Trailing edge)	15.4 - 1.72	178 - 15	No	8.43%
5	Lutron	DVELV-300P	300W 120V / 60Hz	3 Way (Trailing edge)	15.4 - 1.69	178 - 15	No	8.43%
6	Lutron	TG-603PGH	600W 120V / 60Hz	Single way	15.5 - 1.85	173 - 13	No	7.51%
7	Lutron Skylark	CTELV-303P	300W 120V / 60Hz	3 Way (Trailing edge)	15.4 - 1.75	178 - 16	No	8.99%
8	Lutron DIVA	DV-600P	600W 120V / 60Hz	Both	15.5 - 1.6	178 - 12	No	6.74%
9	Leviton	PRI06	600W 120V / 60Hz	Single way	15 - 0.08	178 - 0	No	0.00%
10	Leviton	6673	600W 120V / 60Hz	Both	15.3 - 0.14	178 - 0	No	0.00%
11	Lutron DIVA	DV-603PG	600W 120V / 60Hz	Single way	15.7 - 1.73	174 - 12	No	6.90%
12	Leviton	IPI06	600W 120V / 60Hz	Both	15.3 - 3.1	178 - 21	No	11.80%
13	Lutron	S-600H-WH	600W 120V / 60Hz	Single way	15.28 - 0.62	178 - 2	No	1.12%

Triac Dimmer Compatibility (2)

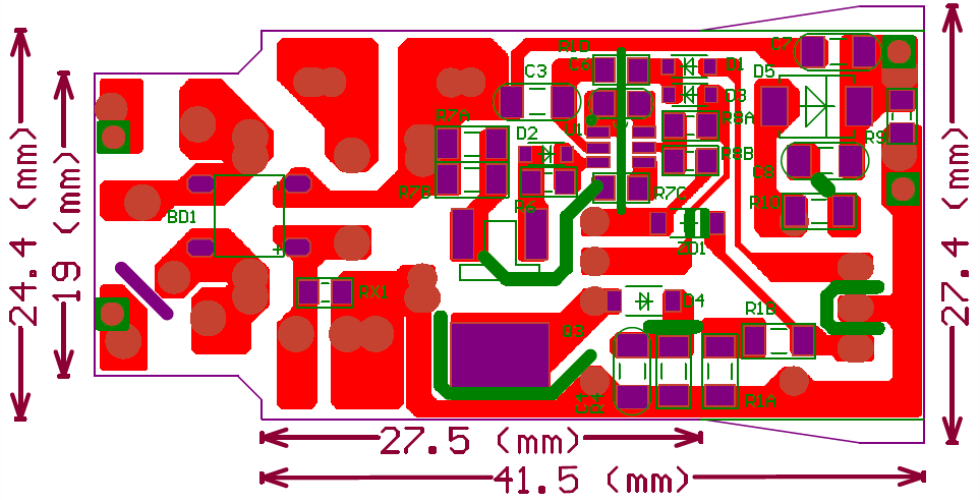
Item	Brand	Model	Load MAX. (Unit:W)	Poles	Dimming Range (in watts)	Led current Range (Unit:mA)	Flickering situation	Brightness duty_min (Unit: %)
14	Lutron DIVA	DVCL-153PD	600W 120V / 60Hz	Single way	15.5 - 4.7	178 - 46	No	25.84%
15	Lutron DIVA	CTCL-153PD	600W 120V / 60Hz	Single way	15.5 - 4.69	178 - 46	No	25.84%
16	Leviton	6615-P	300W 120V / 60Hz	3 Way (Trailing edge)	15.2 - 8.32	178 - 94	No	52.81%
17	Leviton	6681	600W 120V / 60Hz	Both	15 - 0.08	178 - 0	< 7mA slow flicker	0.00%
18	Lutron	D-600PH-DK	600W 120V / 60Hz	Both	15.5 - 0.09	178 - 0	< 5mA slow flicker	0.00%

PCB Layout

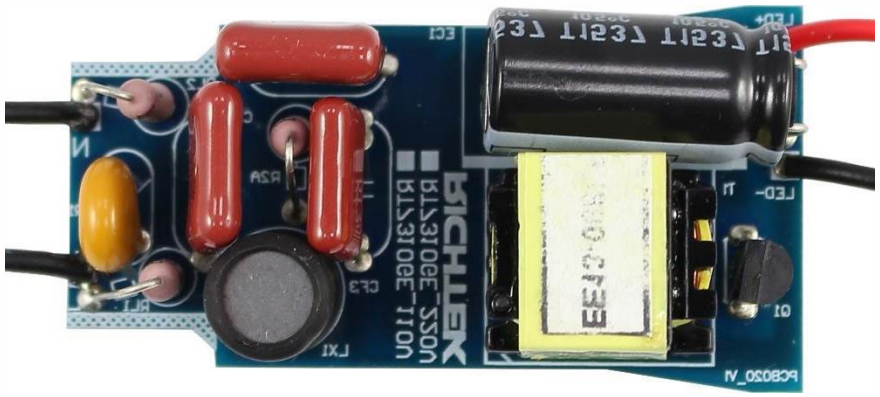
TOP Layout

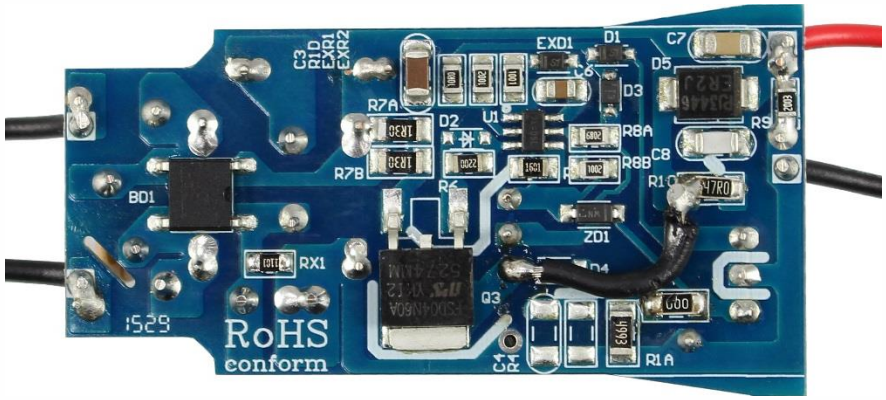


BOT Layout



Demo Board Photo





PCB No : PCB020_V1

BOM

Item	Location	Value	Type
1	RL1 RL2	10R/1W	R1WR_P5
2	VR1	TVR07431	CAP-7MM-CYR
3	BD1	TB6S	TBS
4	U1	RT7310	SOT23-6L
5	LX1	4.7mH	DR0810
6	T1	820uH	EE1310
7	Q1	01N60F	TO-92
8	Q2	FTD04N60A	TO-252
9	D1 EXD1	WS1N4148	SOD-323
10	D3	BAV21	SOD-323
11	D5	ER2J	SMB
12	ZD1	22V	SOD-123

BOM

Item	Location	Value	Type
13	CF1	0.1uF/450V	CL21-7.5/10LE-D
14	CF2	0.22uF/450V	CL21-7.5/10LE-D
15	CF3	0.15uF/450V	CL21-7.5/10LE-D
16	C3	4.7uF/50V	1206
17	C6	1uF/16V	0805
18	C7	2.2nF/630V	1206
19	C8	100pF/630V	1206
20	EC1	100uF/100V	CB10*20LD
21	R1A	499K	1206
22	R1D	10R	0805
23	R2A	820R/1W	R4*5.5LE
24	R6	220R	0805

BOM

Item	Location	Value	Type
25	R7A R7B	1R3	1206
26	R7C	1.6K	0805
27	R8A	68K	0805
28	R8B RXR1	10K	0805
29	R9	200K	0805
30	R10	47R	1206
31	RX1	3K	0805
32	EXR2	1K	0805

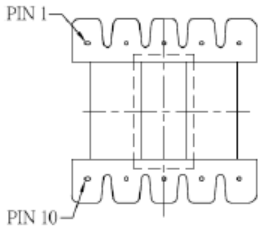
Total: 36pcs

Transformer

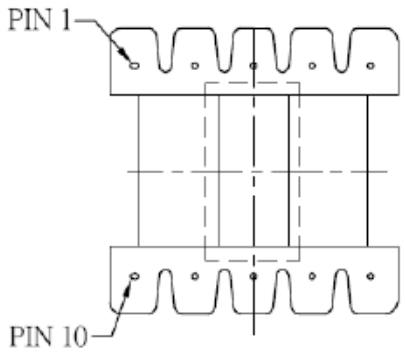
Vender :	豐達		
CORE SIZE:	EE1310	Material:	PC40
Bobbin/PINs:	Vertical / 10 pins		
Primary inductor: (+-10%)	820uH		
Leakage inductor:	N/A		
Test condition:	1kHz/1V		
Varnish :	Yes		

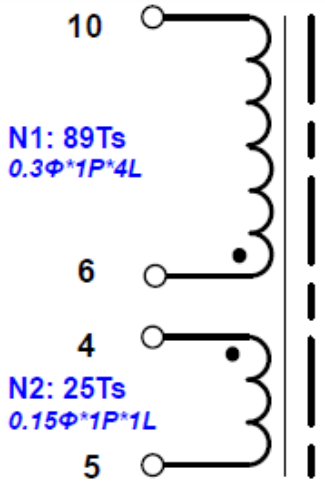
Electrical :

Bottom View



Bottom View





Winding No. (組別)	PIN (腳位)	Wire & Wire & Copper (線徑 x 股數 x 層數)	Turns (圈數)	Winding Type (繞線方式)	Tape Layer (膠帶層次)
	Bobbin				
N1	6 → 10	0.3x 1P x 4L	89Ts	密繞	2L
N2	4 → 5	0.15 x 1P x 1L	25Ts	密繞	2L
	Core – EE1310			820uH	

Power Component Voltage Stress

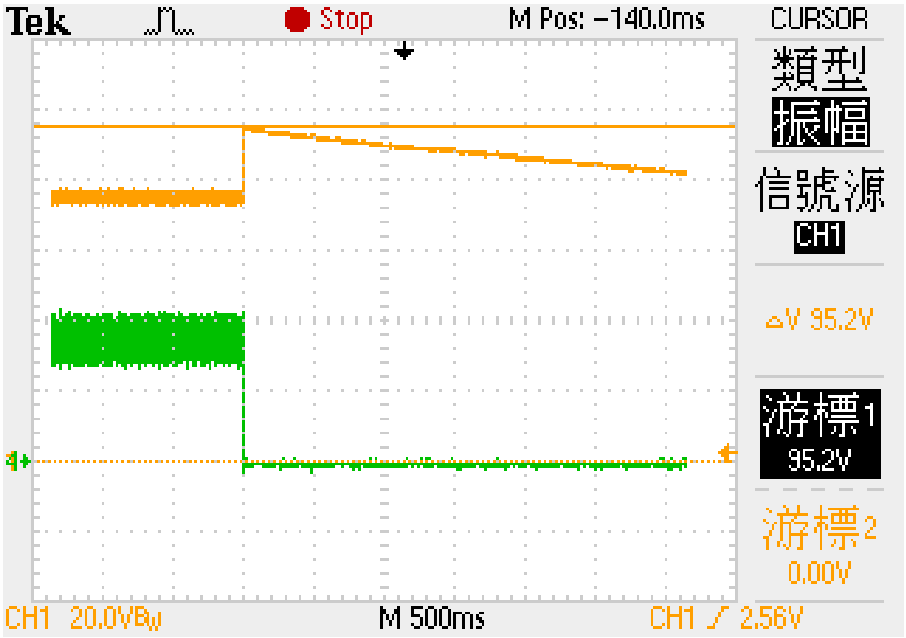
Test condition: 132Vac/60Hz input / 75V, 180mA output

Stead state			
Location	Max rating (V)	Measure	De-rating
Q1	600	264	44%
D1	600	272	45%

Transient State			
Location	Max rating (V)	Measure	De-rating
Q1	600	264	44%
D1	600	272	45%

LED Open Protection

Vac_in = 120V

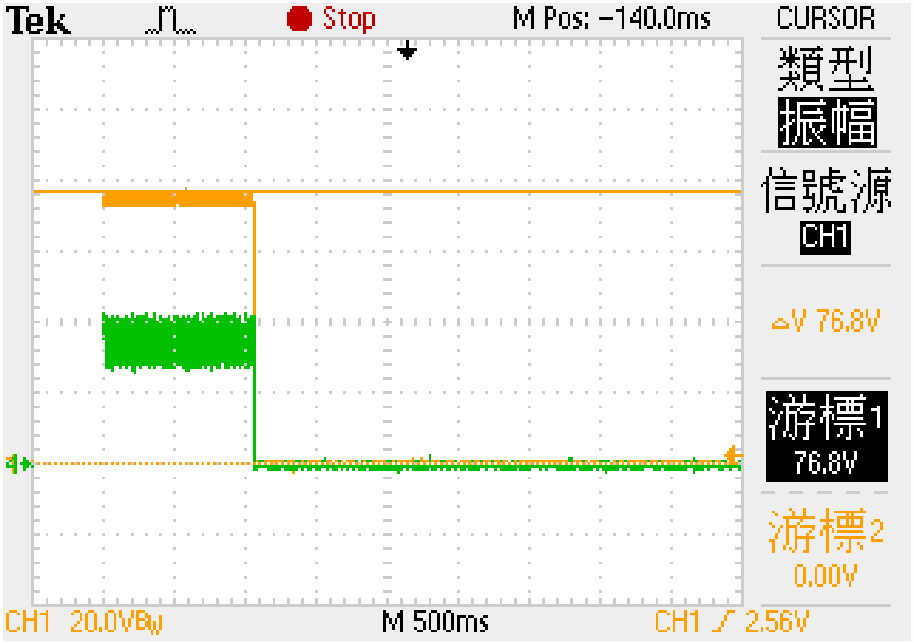


CH1:I_LED, CH4:V_LED

When LED open , the output keeps rising and causing the V_{ZCD} rising accordingly. If Vzcd trigger the protected level(2.9V~3.3V), the IC latch down.

LED Short Protection

Vac_in = 120V

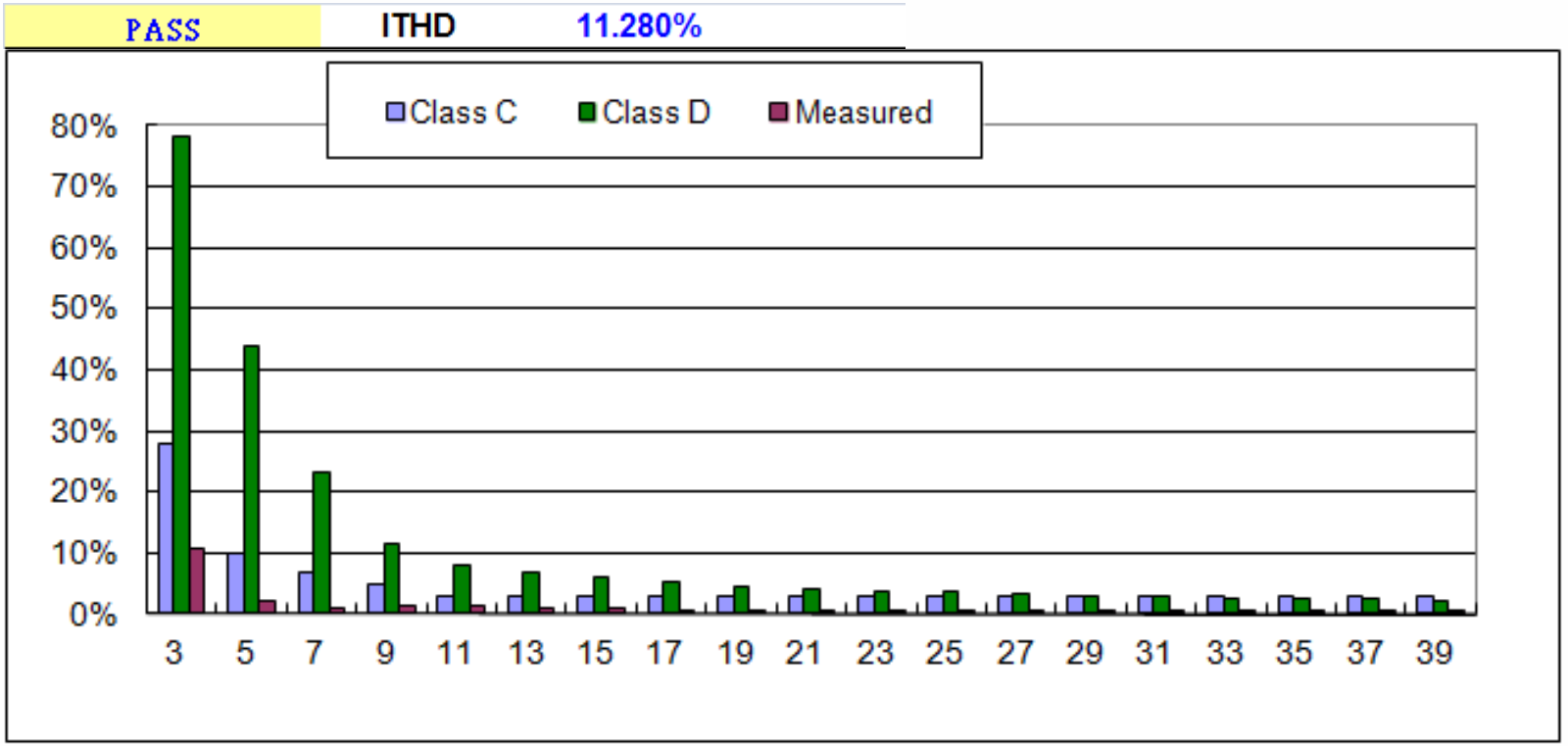


CH1:I_LED, CH4:V_LED

When LED short , the output level is 0V and the Vcs will rise to trigger the protected function. IC will be auto-restarted when the output is recovered.

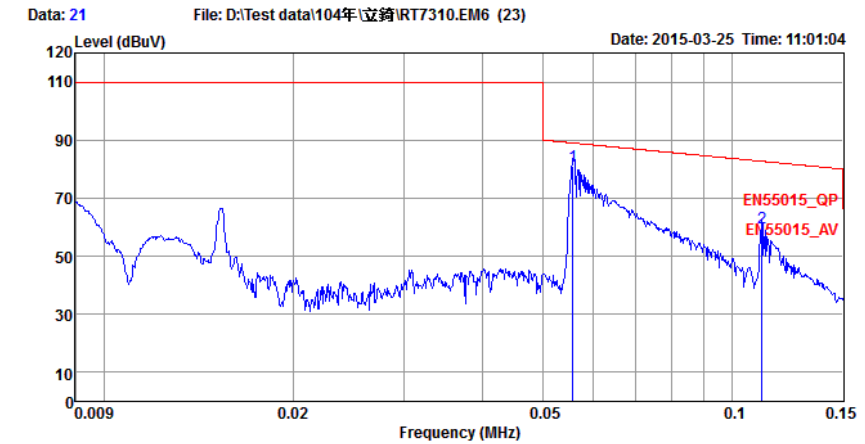
Harmonic(IEC61000-3-2)

110Vac input
Class C : Pass
Class D : Pass



Conduction EMI (1)

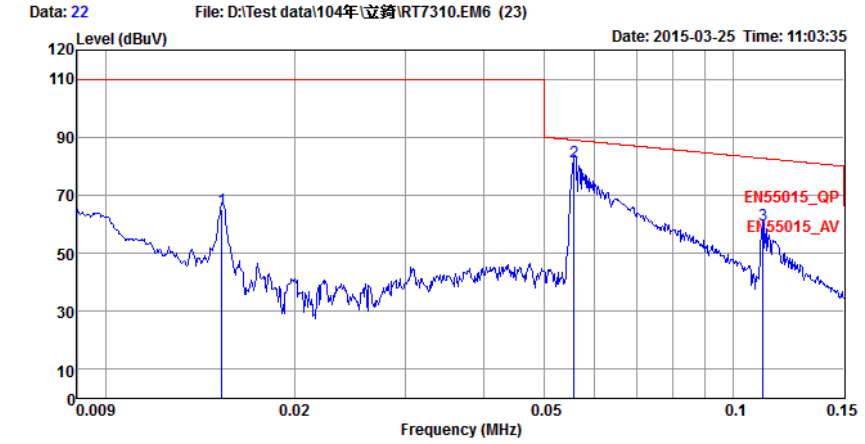
110Vac/60Hz-L1 ➔ Pass



Condition: EN55015_QP LISN-03-09-2015 LINE
Engineer : Parody
EUT : RT7310
Power : 110V
Mode :
Mome1 :
Mome2 :
Mome3 :
Mome4 :

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Pol/Phase	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1 pp	0.06	81.18	-7.83	89.01	71.18	9.98	0.02	LINE	QP
2	0.11	59.73	-22.98	82.71	49.78	9.93	0.02	LINE	QP

110Vac/60Hz-L2 ➔ Pass

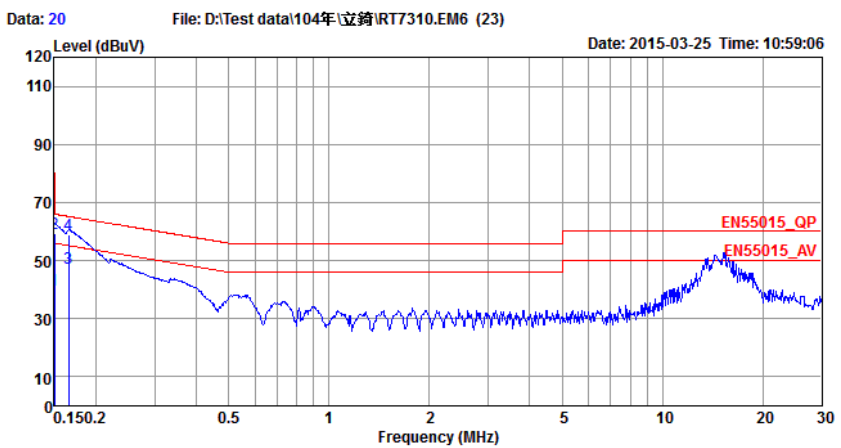


Condition: EN55015_QP LISN-03-09-2015 NEUTRAL
Engineer : Parody
EUT : RT7310
Power : 110V
Mode :
Mome1 :
Mome2 :
Mome3 :
Mome4 :

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Pol/Phase	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.02	64.98	-45.02	110.00	54.56	10.40	0.02	NEUTRAL	QP
2 pp	0.06	81.36	-7.65	89.01	71.51	9.83	0.02	NEUTRAL	QP
3	0.11	59.66	-23.05	82.71	49.86	9.78	0.02	NEUTRAL	QP

Conduction EMI (2)

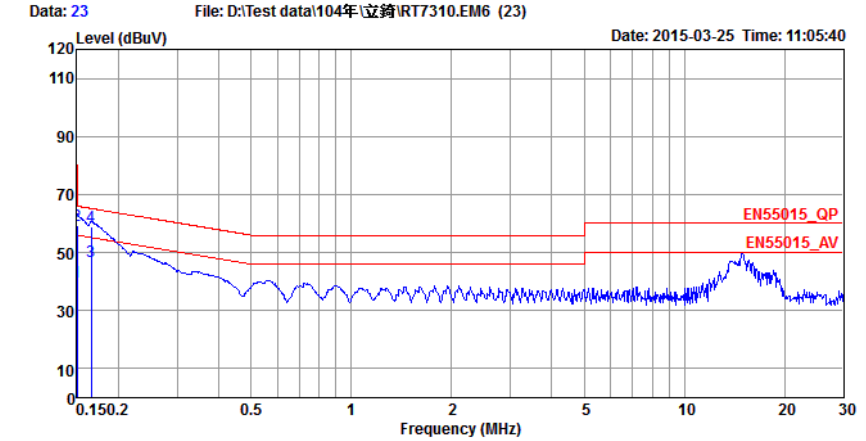
110Vac/60Hz-L1 ➔ Pass



Condition: EN55015_QP LISN-03-09-2015 LINE
Engineer : Parody
EUT : RT7310
Power : 110V
Mode :
Mome1 :
Mome2 :
Mome3 :
Mome4 :

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Pol/Phase	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.15	39.79	-16.21	56.00	29.84	9.93	0.02	LINE	Average
2	0.15	59.41	-6.59	66.00	49.46	9.93	0.02	LINE	QP
3 av	0.17	47.22	-7.94	55.16	37.27	9.93	0.02	LINE	Average
4 pp	0.17	58.98	-6.18	65.16	49.03	9.93	0.02	LINE	QP

110Vac/60Hz-L2 ➔ Pass



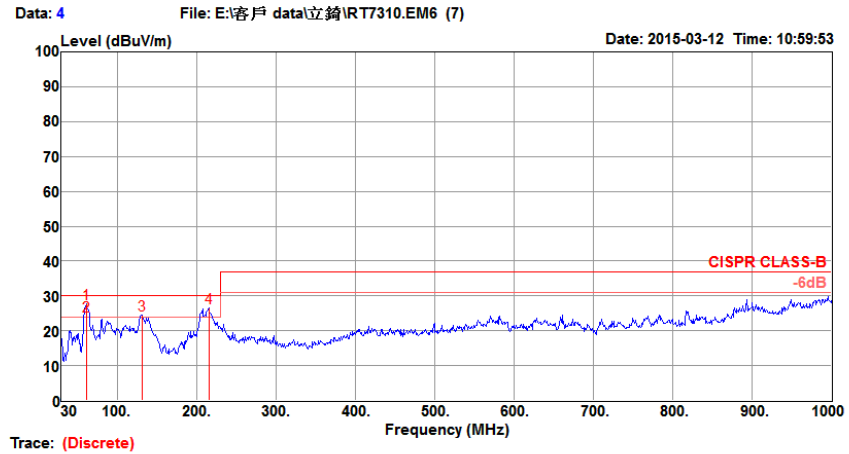
Condition: EN55015_QP LISN-03-09-2015 NEUTRAL
Engineer : Parody
EUT : RT7310
Power : 110V
Mode :
Mome1 :
Mome2 :
Mome3 :
Mome4 :

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Pol/Phase	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.15	40.01	-15.99	56.00	30.21	9.78	0.02	NEUTRAL	Average
2	0.15	59.28	-6.72	66.00	49.48	9.78	0.02	NEUTRAL	QP
3 av	0.17	46.95	-8.21	55.16	37.15	9.78	0.02	NEUTRAL	Average
4 pp	0.17	58.97	-6.19	65.16	49.17	9.78	0.02	NEUTRAL	QP

Radiation EMI

110Vac/60Hz-V ➔ Pass

SPORTON LAB.
No. 8 Lane 724, Bo Ai Street, Zhubei City,
Hsin Chu Hsien 302, Taiwan, R.O.C.
TEL:03-656-9065
FAX:03-656-9085

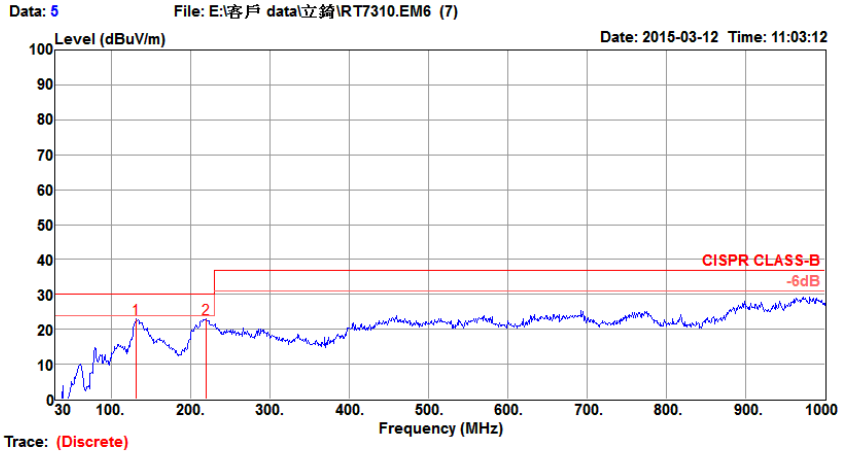


Trace: (Discrete)
Condition: CISPR CLASS-B 10m BILOG ANT 20141111 VERTICAL
: RBW:100.000KHz VBW:300.000KHz SWT:0.500sec
Engineer : Hank
Eut : RT7310
Mode : Normal
Power : AC 110V/60Hz
Memo 5-1 : 220R
Memo 5-2 :

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	61.04	27.60	30.00	-2.40	52.63	0.68	6.89	32.30	100	273	Peak	VERTICAL
2	61.04	24.17	30.00	-5.83	49.20	0.68	6.89	32.30	100	273	QP	VERTICAL
3	130.88	24.52	30.00	-5.48	48.47	0.99	12.64	32.22	100	151	Peak	VERTICAL
4	215.27	26.46	30.00	-3.54	45.99	1.28	10.75	32.06	200	130	Peak	VERTICAL

110Vac/60Hz-H ➔ Pass

SPORTON LAB.
No. 8 Lane 724, Bo Ai Street, Zhubei City,
Hsin Chu Hsien 302, Taiwan, R.O.C.
TEL:03-656-9065
FAX:03-656-9085



Trace: (Discrete)
Condition: CISPR CLASS-B 10m BILOG ANT 20141111 HORIZONTAL
: RBW:100.000KHz VBW:300.000KHz SWT:0.500sec
Engineer : Hank
Eut : RT7310
Mode : Normal
Power : AC 110V/60Hz
Memo 5-1 : 220R
Memo 5-2 :

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	131.85	23.01	30.00	-6.99	51.37	1.00	12.58	32.21	200	174	Peak	HORIZONTAL
2	219.15	22.99	30.00	-7.01	50.24	1.29	10.71	32.08	150	188	Peak	HORIZONTAL

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thank you.